

ordinary domestic varieties; and in all the many foals born in the Gardens between our Somaliland Ass and domestic asses of English and Spanish breeds, the ear-patch, shoulder and spinal stripes were present as in the dams.

The above stated facts suggest that, with the possible exception of the ear-patch in horses, the shoulder and spinal stripes as well as the stripes on the legs have been lost comparatively recently by the species that are without them.

PAPERS.

45. Contributions to the Anatomy and Systematic Arrangement of the Cestoidea. By FRANK E. BEDDARD, M.A., F.R.S., F.Z.S., Prosector to the Society.

[Received May 23, 1911: Read June 27, 1911.]

(Text-figures 204-215.)

II. ON TWO NEW GENERA OF CESTODES FROM MAMMALS.

The following communication to the Society contains an account of the anatomy of two species of Tapeworms, contained in the collection of Cestoidea belonging to the Society. I feel it necessary to refer them to new genera, and the facts which I shall presently bring forward will I hope justify my so doing. The first of these species is certainly near to *Thysanosoma*, and is, as I think, clearly to be referred to the same genus as a species recently described by me * and temporarily referred to the genus *Thysanosoma*. I pointed out, however, in that paper a number of differences from other tapeworms referred to the genus *Thysanosoma*, and intimated that it probably would be necessary to institute a new genus for the worm. This expression of opinion is justified by the discovery of a second species which is clearly of the same genus. The second species considered in the present paper was placed by me temporarily, and in a report to the Prosectorial Committee, in the genus *Bertiella*. It shows, however, some affinities to *Tenia* (*sensu stricto*) and seems on account of various peculiarities, which in due course will be pointed out, to demand the creation of a separate genus.

I shall commence with an anatomical description of the new species allied to *Thysanosoma*; this I place in a new genus which I propose to call *Thysanotenia*.

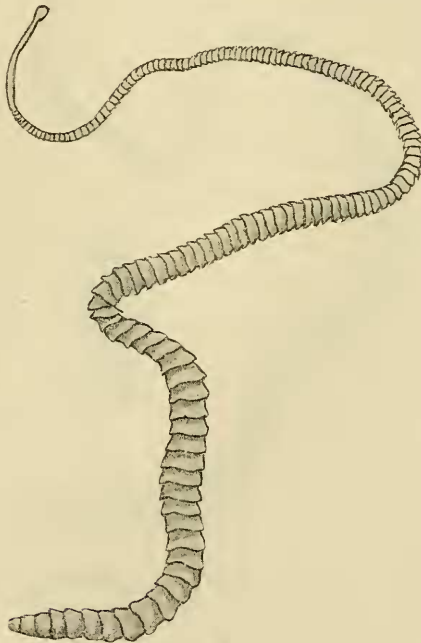
Thysanotænia lemuris, gen. et sp. n.

An example of a Black-headed Lemur (*Lemur macaco*), which had lived in the Gardens three years and three months, contained

* See No. I. of this series, P. Z. S. 1911, p. 651.

two perfect examples, and a number of large fragments, of a tapeworm which I refer to the above new genus and species. There is, as it appears to me, no doubt whatever that these tapeworms belong to the same genus as a species which I have recently described in the "Proceedings"* of this Society as *Thysanosoma gambianum* from the Gambian Pouched Rat (*Cricetomys gambianus*). The external characters are in very near agreement. The present species agrees with *Thysanosoma gambianum* in the unarmed head, in the fact that the segments increase in length posteriorly but are never longer than broad, that the genital apertures are unilateral, and that the eggs are enclosed in a numerous series of paruterine organs in the fully mature segments. This set of characters is sufficient to refer the present species, as well as *Thysanosoma gambianum*, to the subfamily Thysanosominae of the Anoplocephalidae.

Text-fig. 204.

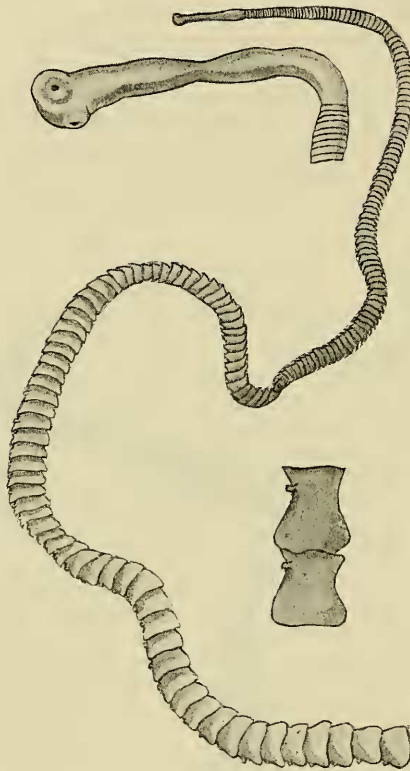
*Thysanotenia lemuris*, about twice natural size.

Of the two specimens which possessed a scolex, the larger (text-fig. 205) measured at least four inches in length, and was probably longer as it ended abruptly and without a definite terminal

* Above, p. 651.

proglottid, such as was visible in the younger, smaller, example (text-fig. 204). Furthermore, among the fragments was one measuring nearly five inches in length, which may, for what I know to the contrary, have belonged to the first mentioned individual, since it consisted entirely of mature proglottids, which were of greater length individually than the terminal proglottids of the specimen

Text-fig. 205.



Thysanotænia lemuris, a second specimen. Above and to the left is the scolex more highly magnified; below and to the right, two segments of another individual showing the papillæ which bear the genital pores.

described and figured in this communication. The longest proglottids of the mature fragment were rather more than 3 mm. long, and rather less than 3 cm. wide at the posterior end of the proglottid, which is considerably wider than the anterior end.

The proglottids have no fringes posteriorly such as are present in *Thysanosoma* and provide the reason for the name given.

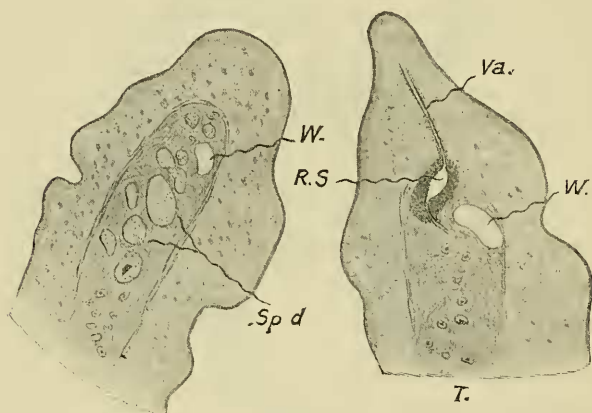
The scolex (text-fig. 205) is of moderate dimensions, not very minute, and quite visible as such by the naked eye. It is more or less spherical, and is marked by some black pigment below the level of the suckers. A pigmentation of the suckers is not uncommon among the Cestoidea, and it seems occasionally to pervade the scolex also. The suckers have a circular orifice, and present no marked features on examination with a lens. They lie some way below the summit of the scolex, and are directed laterally; there is no trace, that I could see, of an upward direction. The smoothly rounded upper end of the scolex shows no hooks. The suckers lie near to the lower end of the head, which is followed by a distinct neck of 2 or 3 mm. in length, in which the strobilisation was not apparent. The strobila are at first much broader than long, and each overlaps its successor at the edges. In the larger specimen, the dimensions of which are given above, the proglottids did not attain to an equality in length and breadth until about three inches or so from the scolex. They never attain to a length which is greatly in excess of their breadth, as will be apparent from the measurements which I have given above. It is noteworthy that in the smaller of the two individuals which are described here, the very few last segments alone showed a length equal to their breadth. In this worm (text-fig. 204) the last proglottid had an oval form, and was of less diameter than those which immediately preceded it. This form is usual for the last proglottid, and serves to emphasize the fact that this specimen was complete and had not begun to cast off proglottids. The ripe proglottids differed from the anterior ones in their greater thickness, and in the fact that their surface was marked by a longitudinal furrowing, caused as I should imagine by unequal distention with embryos. The shape of these proglottids also was different from that of those lying in front, in that they were hourglass-shaped, with, however, as has already been mentioned, a greater diameter posteriorly than anteriorly. The genital pores are unilateral without exception from end to end of the body. They are not at all visible until the segments have begun to increase in length, and are perhaps less obvious upon the very distended posterior proglottids. The pores are particularly obvious in this species, on account of the fact that they are borne upon slender processes of the body-wall, as will be more specially described later in connection with the generative organs. These genital processes lie near to the anterior border of the segments.

If the above account of the external characters of this tapeworm be compared with my account of the external characters of *Thysanotenia gambiana*, it will be seen that the two species, though agreeing in many features, nevertheless show several points of distinction, which enable them to be fully defined as distinct species from these external characters only. It is particularly to be noted that the individual of the two examples of *Thysanotenia lemuris* which I regard as a not fully developed

worm is like the adult *Thysanotenia gambiana* in its characters. Thus the proglottids do not increase at all appreciably in length until the very end of the body, those anterior to this being broader than long. It is, however, clearly a difference between the two species that there are in *Thysanotenia lemuris* a much longer series of proglottids of greater length than diameter, and that the conical projection of the body which bears the generative pore is more pronounced. Furthermore, while the species described in the present communication has a long neck, there is no neck in *Th. gambiana*, the strobilisation commencing immediately after the scolex. Finally, *Th. lemuris* has black pigment in the scolex, which is wanting in *Th. gambiana*. There are thus several obvious differences between the species, which as I think prevent any confusion between them.

In transverse sections (text-figs. 206, 207) it was only possible to see a single *water-vascular tube* on each side. This is of considerable diameter, though it fluctuates in size from place to place

Text-fig. 206.



Thysanotenia lemuris. Two sections across a proglottid, one of which (on the right) shows the genital papilla. The half only of each complete section is shown. *R.S.*, Receptaculum seminis; *Sp.d.*, sperm-duct; *T.*, testes scattered in parenchyma; *Va.*, vagina; *W.*, excretory tube.

and is connected with its fellow in each proglottid by a transverse tube, which lies near to the posterior boundary of the proglottid. The single water-vascular tube of this species appears to represent by its position the innermost of the two tubes found in *Thysanotenia gambiana*. I could find no network of minute tubules arising from these, such as are obvious in the last mentioned species.

Genital organs.—On the whole, the genital system of the species dealt with in the present communication is not very like that of *Thysanotenia gambiana*. There is, however, a very important

point of agreement, in the similarity of the enclosure of the eggs in numerous paruterine organs, which perhaps outweighs the various dissimilarities which will be dealt with in considering the testes and the ovaries and their ducts. The *testes* occupy in *Thysanotania lemuris* a quite different position in the body from that which they occupy in *Th. gambiana*. They lie in the former species entirely between the water-vascular tubes, and in the medullary region of course of each proglottid. Like the other organs of the genital system, they commence to be visible rather late in the body, thus contrasting very markedly with the conditions obtaining in the second genus described in the present paper. The testes lie mainly in the posterior region of each proglottid, but in front of the transverse water-vascular vessel. They form continuous rows each only one deep, and not, except perhaps here and there, at all crowded. The testes are also extended anteriorly to quite the front end of the proglottid on either side of the ovaries.

The *cirrus sac* is divided, but not sharply, into two regions. The terminal part which encloses the cirrus is narrow, and this tube expands posteriorly into an oval vesicle of much greater dimensions. The whole structure has in fact much the shape of a soda-water bottle. The hinder part of the sac is about on a level with the receptaculum seminis and the sac itself is gorged with sperm, the whole of the available space being filled with a mass of sperm. It is encircled by a thick layer of muscle fibres which run longitudinally to the longer axis of the sac, and form a continuous coat passing in this direction to all round the sac when it is viewed in longitudinal section, that is in transverse sections of the proglottid. At the posterior end the thick muscular layer is interrupted for a minute space, to permit of the entrance of the sperm-duct which narrows greatly at its entrance into the cirrus sac, or rather into that part of the cirrus sac which is specialised as a vesicula seminalis. This narrow region of the vas deferens immediately widens out into a long tract of duct, which may be regarded as a second vesicula seminalis. This tube is wide, quite as wide as in species of *Bertiella*, and is coiled upon itself as it passes back towards the opposite extremity of the body. This region of the sperm-duct would be, if unwrapped from its coiling, of considerable length; I found it to be gorged with sperm. The cirrus itself was generally protruding from the genital aperture. It is not large and has the usual structure of this organ. The difference which it shows from the sperm-duct is very striking, and furnishes an argument in favour of those who would hold that the cirrus is not merely the end of the sperm-duct which is capable of protrusion. It seems in this species at any rate to be a structure independent of the sperm-duct. There is a certain resemblance between the bottle-shaped cirrus sac and the bottle-shaped receptaculum seminis and the end of the vagina. Both of these tubes lie to the same side of the lateral excretory vessels—

if we are to regard the ovary as ventral, they lie to the dorsal side.

The vaginal pore lies behind the opening of the male duct into the genital cloaca. The vagina is a perfectly straight, delicate-walled tube as in so many tapeworms. Posteriorly and close to the lateral water-vessel, the vagina expands into a somewhat pear-shaped receptaculum seminis, from the wider, posterior end of which the vagina emerges again abruptly and runs a curved oblique course towards the ventral side of the body. This latter region of the vagina is of the same calibre and appearance as the terminal section which opens into the genital cloaca. The swollen receptaculum seminis (text-fig. 206, p. 998) has on the other hand thick glandular walls. The ovary and the yolk-gland lie anteriorly in each proglottid and very nearly in the middle of the proglottid, verging however to the pore side, the position being therefore quite different from that which characterises *Thysanotenia gambiana*. The ovary is not large, neither is the yolk-gland.

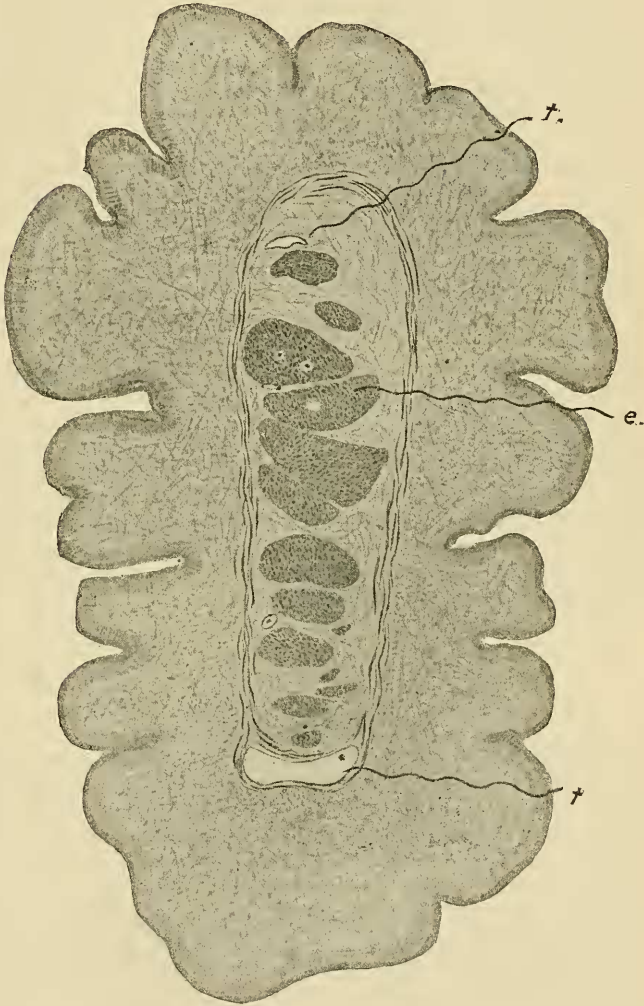
Whether a uterus exists as a definite structure at any period in the development of the sexual organs, I am not able to state with certainty. But I am disposed to think that a distinct uterus does not exist. At the most, it must have a very brief existence, for I can find nothing intermediate between eggs scattered in the parenchyma and in the paruterine organs. I found nothing like what has been described in *Thysanosoma*. In this genus there are stated to be outpocketings of the uterus round each of which is formed a paruterine organ. I found in the present species a condensation of the parenchyma round eggs or groups of eggs, precisely as I have described in *Thysanotenia gambiana*. These latter became more marked, and were then to be described as paruterine organs. In fact, the state of affairs which characterises the genus *Thysanotenia* is to be looked upon as a further stage in the development of such a genus as *Oochoristica* with the intermediate formation of a uterus dropped out, or at least rendered of very little importance. It is also like *Davainea*.

Text-figure 207 represents a transverse section through a fully mature proglottid of this worm. It may be compared with a corresponding illustration of the other species of the genus, *Thysanotenia gambiana**, when certain differences will be apparent coupled naturally with fundamental points of agreement. In both species, the greater part of the medullary region of the segment is occupied by the numerous paruterine organs, which are only one layer deep. They extend between the excretory vessels and up to those vessels on either side. In *Thysanotenia lemuris*, however, the transverse row of paruterine sacs is at most thirteen to sixteen, while they are much more numerous in *Th. gambiana*. Furthermore, in a given section the greater number by far—very often all—of the paruterine organs are seen to be

* P. Z. S. 1911, text-fig. 158, p. 658.

without a contained embryo or embryos. This does not mean, of course, that these are paruterine organs which contain no eggs. It is simply an expression of the fact that in the present

Text-fig. 207.



Thysanotenia lemuris, transverse section through ripe proglottid, showing the longitudinal external furrowing of the proglottid. *e.*, paruterine organs, in only two of which were eggs to be seen in this particular section; *t.*, excretory tubes.

species each paruterus contains fewer eggs (or embryos) than is the case with *Thysanotenia gambiana*. In no case have I seen in a given section more than three embryos within a single paruterine sac in the species which forms the subject of the present communication. In reference to this particular I may compare text-figure 207 with the text-figure of my paper dealing with "*Thysanosoma*" *gambianum**. The paruterine organs themselves were of about the same size in the two species. The presence of so few embryos in a single paruterine sac produces naturally a very distinctive appearance which at once distinguishes the two species from each other. In each paruterine organ of *Th. lemuris* it was possible to distinguish a cortical and a medullary region of different appearance. That this was not possible in the other species is probably to be accounted for by the large number of embryos which filled them.

It will, I think, be admitted that this tapeworm presents characters which will not fit in with those of any known genus. It contradicts indeed the definitions of families as given by Ransom, at any rate to some extent; for I should be disposed to place the genus in the neighbourhood of *Thysanosoma* in the family Anoplocephalidæ; and yet this family is characterised by the absence of a neck, present in the genus which is now under consideration. The only other position in the series which this worm could occupy, as I think, is in the subfamily Paruterinæ of the family Hymenolepididæ; but in this subfamily the paruterine organs are limited to one or two, and there is nothing like the numerous organs met with in both of the species which I describe here under the generic name of *Thysanotenia*. This latter reason as well as the unilateral genital pores prevent the inclusion of the species in the genus *Stilesia*.

This new genus, *Thysanotenia* †, may be thus defined:—

***Thysanotænia*, gen. nov.**

Moderately large tapeworms, four to six inches in length and three millimetres in breadth. Scolex unarmed, with laterally placed suckers. Proglottids posteriorly as long as or slightly longer than broad. Genital pores unilateral, borne upon a projection of the body near to the anterior end of proglottids. Ecretory tubes wide, one or two (and these lying side by side) on each side, with or without ramified branches. Reproductive organs a single set in each segment. Testes numerous, or very numerous. Uterus a narrow transverse sac or absent. Many paruterine organs in ripe segments. Eggs without pyriform apparatus. Adults in Mammals.

* *Loc. cit.* text-fig. 159, p. 659.

† Inasmuch as there are no fringes to the proglottids posteriorly such as occur in *Thysanosoma*, the name selected is rather a misnomer. I have, however, used it more for the purpose of fixing what I consider to be the systematic position of the worm.

Accepting the above as the generic characters of the genus *Thysanotænia*, the two species may be thus defined :—

(1) *Thysanotænia gambiana* F. E. B.

Thysanosoma gambianum Beddard, P. Z. S. 1911, p. 651.

Length about six inches, greatest diameter 6 millimetres. Segments never longer than broad and only a few at the posterior end as long as broad. Genital papilla not very conspicuous. Two excretory tubes on each side, the inner of the two the larger, placed laterally to each other; a network of fine tubules connected with these. Testes in two groups, the larger lying on the side furthest from the genital pore, occupying the space between the two excretory tubes of that side and a little beyond on each side. Ovary and yolk-gland on pore side lying between the two excretory tubes and a little to the inner side also. Sperm-duct narrow or coiled, with a small vesicula seminalis. No receptaculum seminis; vagina opens into a terminal muscular sac. Paruterine organs each with many embryos. Uterus a transverse sac.

Host, Gambian Pouched Rat (*Cricetomys gambianus*).

(2) *Thysanotænia lemuris*, sp. n.

Length four to six inches with diameter of three millimetres. Segments at end of body rather longer than broad. Genital papilla very conspicuous. One excretory tube on each side of body corresponding to the innermost of the two present in *Th. gambiana*. No network of tubules connected with this. Testes scattered through posterior part of the body and anteriorly to the sides of ovary. Ovary and yolk-gland submedian in position, slightly to pore side of segment. Sperm-duct wide and coiled after issuing from cirrus sac. Receptaculum seminis present. Paruterine organs with only three or four embryos in each. A uterus not formed (?).

Host, Black Lemur (*Lemur macaco*).

It is obvious from the above definition and from what has been said in the course of this paper that the two species, which I assign to this new genus *Thysanotænia*, differ from each other in a good many points, and perhaps may be considered to merit generic separation.

Anoplotænia dasyuri, gen. et sp. n.

At about the same time, *i. e.* from February 9th–11th, 1911, three examples of the Tasmanian Devil (*Dasyurus ursinus*) died in the Gardens; only one of them was found to contain tapeworms, and these occurred in that example in very great numbers. The specimens belong, as I believe, to a new species, and I am also disposed to form for it a new genus, which is to some extent allied to the Anoplocephalidæ, but also, in the form of the uterus, suggests *Tenia*, *sensu stricto*. These facts have suggested the

generic name which I here propose. I considered after a rough examination of the worm that it might possibly be referred to the genus *Bertiella*, and suggested this in a report to the Prosectorial Committee; I am now convinced that it cannot be included in that genus and that its characters will not allow of its inclusion in any known genus. The movements of the living worm were particularly active. The worm is not a long form and has a rather unusually large head, as will be gathered from the

Text-fig. 208.



Anoplotaenia dasyuri, enlarged about five times.

accompanying figure (text-fig. 208). I could find no trace of any hooks or of any terminal sucker or other structure in the rostellar region. The four suckers are unarmed and of large size.

The scolex is well marked off from the strobila, although there is no obvious neck—that is to say, the segmentation begins apparently at once. This is brought about not only by the

actually large size of the head but by the fact that the first strobila are much narrower than those immediately following, and thus an apparent constriction occurs which emphasizes the distinction of the head. In other cases the conditions are apparently the same; but an examination with a lens shows that though a constriction at about the same distance from the rostellum exists, the formation of strobila exists beyond this point and has invaded the hinder region of the actual scolex. It is a little difficult therefore to assert that a neck is or is not characteristic of *Anoplotenia dasypuri*. The occasional commencement of strobilisation immediately behind the scolex is not unsuggestive of *Oochoristica**, with which genus the present has some likeness, and there is in the same way a kind of hint of a commencing pseudoscolex.

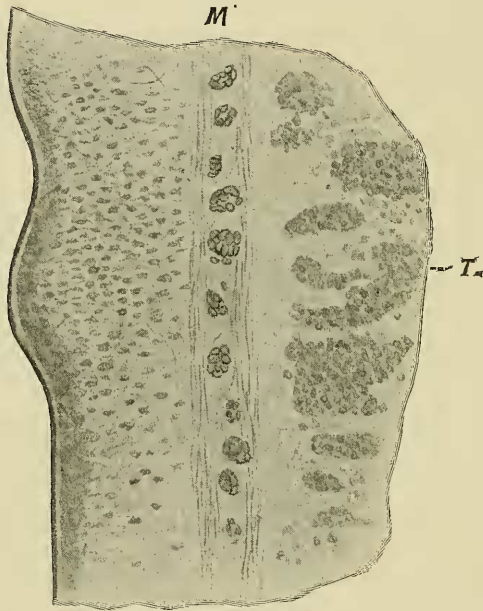
The body of the worm is about an inch in length or sometimes rather longer; but it never grows to a great size. The segments which immediately follow the head are very short; but this region of the body is not long, perhaps a couple of millimetres, and contains but few segments, in some cases not more than a dozen, in others rather more. The segments increase gradually in length and towards the end of the body come to be three or four times as long as they are broad. In the hinder segments the genital pores are sometimes quite obvious when the worm is examined with a lens, and irregularly alternate in position from one side of the body to the other. In transverse sections the body is apt to be hourglass-shaped owing to the greater thickness of the lateral edges of the body due to the bulging caused by the unusually large cirrus sacs. This is certainly the case with the shorter and flatter anterior proglottids.

In transverse sections, through the anterior region of the body in mature segments, which are, however, not long and distended with ova, the layers of the cortex can be readily distinguished. The cortex (text-fig. 209) is of about the same diameter as the medullary portion. It is distinguishable into a much thicker outer layer of longitudinal fibres, and a much thinner inner layer of longitudinal fibres. The two are separated by delicate transversely-running fibres, of which there are also a set within the inner layer of longitudinal fibres and thus bordering upon the medulla. The inner layer of longitudinal fibres is particularly conspicuous for the reason that several are closely grouped into a bundle, of which bundles there is only a single row, as is shown in text-figure 209. This arrangement of the muscular fibres is only apparent in the more anterior segments. It ceases to be obvious in ripe proglottids such as that represented in text-fig. 213 (p. 1012) where the body is gorged with eggs. In these segments however, where, as will be pointed out at length presently, the eggs are partly contained in a uterus and partly scattered singly or in groups through the medullary

* See P. Z. S. 1911, p. 628.

parenchyma, a new set of muscular fibres becomes apparent which I have not observed in the anterior segments and which therefore if really present are not so plain in those segments. The fibres run across the medullary parenchyma in a dorso-ventral direction and apparently belong to the cortical layer of circular fibres. In text-fig. 213 some of these fibres are seen to cross the medullary parenchyma and then to join the longitudinal series of cortical fibres. Possibly these fibres assist in the rupture of the proglottids to expel the eggs, and their presence may also account for the particularly active movements of this species which have been referred to above.

Text-fig. 209.



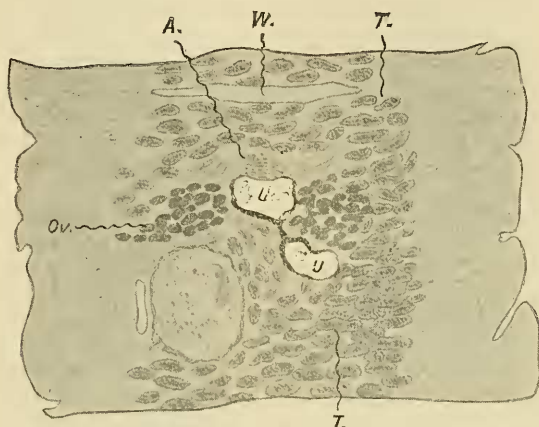
Anoplotania dasyuri, transverse section through part of body-wall. *M*, two delicate layers of circular fibres between which is a special layer of longitudinal fibres grouped into bundles. *T*, testis.

The *excretory vessels* are two on each side and are accurately superposed, *i. e.* dorsal and ventral. Later on in the body only one vessel is very plainly visible on each side, and this is of greater calibre than anteriorly.

The *gonads* and their ducts appear very early in the strobila of *Anoplotania dasyuri*. They commence to be visible within less than 1 mm. of the head immediately after the anterior set of very short segments. The segments, when the ducts are first visible,

are absolutely crammed with apparently mature (certainly very nearly mature) testes. The ducts showed no signs of specialisation. The vas deferens only expanded slightly and gradually into the elongated terminal sac, which is so much specialised in the mature segments to be described later. This immature condition of the ducts persisted for only six segments. Thereafter the cirrus sacs were nearly or quite fully developed. In these anterior segments the ovaries were not so forward in development as the testes.

Text-fig. 210.



Anoplotenia dasyuri, longitudinal section of proglottid. *A.*, shell-gland; *Ov.*, ovary, below which is seen the cirrus sac; *T.*, testes; *U.*, uterus, between which and the cirrus sac are seen the coils of the vas deferens cut transversely; *W.*, transverse excretory tube. The posterior part of the proglottid is above.

The ovaries of *Anoplotenia dasyuri* lie posteriorly in the segment but anteriorly to the vitelline glands, and when fully developed are large and distinctly double. They have the very common bushy form and occupy a good deal of the posterior region of the segment. I did not observe the ovaries to be fully developed until the first segment, in which the cirrus sac is also fully developed and in which the uterus has begun to appear. When the uterus has become so far developed as to fill the greater part of the proglottid, the ovaries quite distinctly lie in continuity with the masses of not fully mature eggs which here fill up the chambers of the uterus.

The vitelline glands are quite evident close to the posterior border of the proglottid; they do not extend out so far laterally as do the ovaries.

The vagina of this worm is, as is so usual in the group, a quite straight tube for the greater part of its extent, that is to say it is not coiled. It lies behind the cirrus sac and opens into the

commencement of the genital cloaca, perforating the muscular pad. Its walls are not distinctly cellular and they stain deeply, both of which features are very common in these animals. Distally, the vagina may be easily followed until it opens into a well-marked receptaculum seminis, which is very large and conspicuous in *Anoplotesnia*. In young segments its course is straight across the segment; in older ones it passes straight to the middle line in an oblique course, then bends back along the middle line of the segment. This sac lies almost exactly in the middle of the body and is absolutely circular in transverse sections of the proglottids. The vagina enters it on the ventral surface and leaves it again at an exactly corresponding point further towards the non-pore side of the proglottid. Thus the tube leaving the receptaculum has to be followed for a short distance in sections before it can be ascertained whether it is the distal or proximal part of the vagina. The receptaculum was gorged with sperm. It is not spherical as might be imagined from its circular contour in section, but narrows to the more slender tube at one end which is beyond the exit of the vagina.

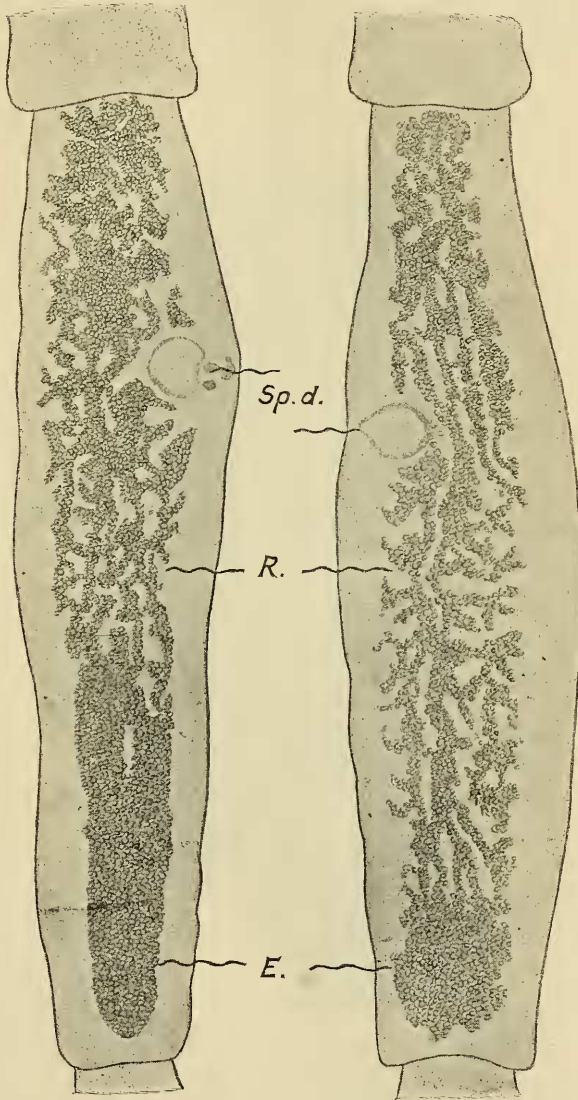
Towards its point of opening into the genital cloaca, the vagina lies parallel to the cirrus sac, in some cases being less oblique in its course than in other proglottids. It has a very thick muscular wall, that is to say thick relatively to the size of its very small lumen. This muscular coat is double, an inner longitudinal and an outer circular layer being present. Opposite the actual point of opening into the genital cloaca, the vagina suddenly widens into a very small sac lying closely adpressed to the muscular pad which forms part of the wall of the genital cloaca; from this sac, a narrow tube passes at right angles to the rest of the vagina and perforates the muscular pad. The terminal sac of the vagina is seen to be filled with sperm. It is related perhaps to the lateral orifice of the cirrus within the invaginated pouch of the cirrus sac: this when protruded forms a bulbous extremity, near to which the orifice would pour its contents into, quite fill and perhaps even somewhat dilate, this terminal sac of the vagina. This matter is, however, more fully dealt with under my description of the cirrus sac and penis (on p. 1014).

I am disposed to think that the receptaculum seminis is no more than a dilatation upon the vagina, for it could easily owe its shape to mere gorging with sperm, and its walls appear to be like those of the rest of the vagina and to have lost their cellular character. It is at any rate greatly disguised in them as in so many other tapeworms. As Gough has lately pointed out,* this non-cellular appearance is preceded by a distinct wall of cells. If the receptaculum seminis be as I suggest merely a local swelling of the vagina, it is clearly quite different in its nature from the receptaculum described above in *Thysanotesnia lemuris*. This latter is most obviously a distinct and definitely specialised region

* "Tapeworms of the subfamily *Avitellina*," Quart. Journ. Micr. Sci. vol. lvi.

of the female tubes. For it is apparent in less mature proglottids and has there walls of a different character from the slender

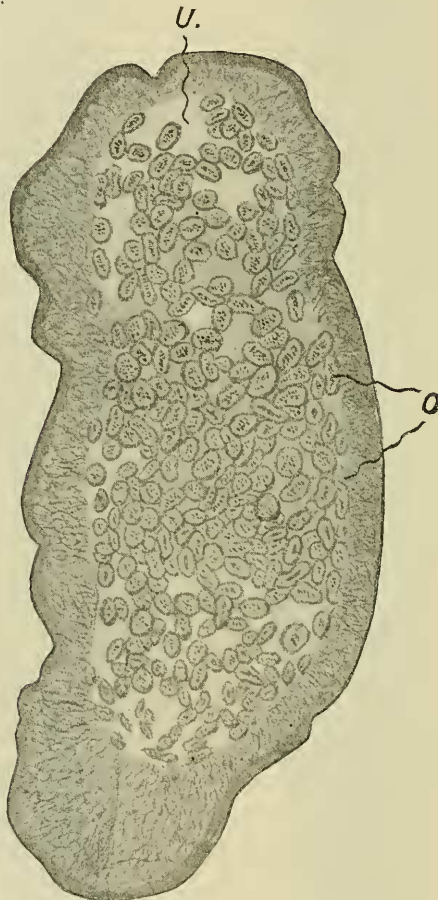
Text-fig. 211.



Anoplotania dasyuri, two ripe proglottids viewed as transparent objects.
E., masses of eggs at posterior end of proglottid; *R.*, reticular portion of uterus;
Sp.d., cirrus sac.

vagina connected with it. And, moreover, in these younger proglottids its shape cannot be due to any distention by sperm, for the sac was quite empty of sperm. It might be convenient to restrict the term receptaculum seminis for cases of this kind, and not perhaps to name specially the distended region of the vagina in which the sperm is chiefly massed in other forms.

Text-fig. 212.



Anoplotenia dasyuri, transverse section through ripe proglottid.

O., ova; U., cavity of uterus.

The *uterus* of this tapeworm is visible very early in the body in correlation with the early development of the organs of repro-

duction generally. I found, in fact, that the uterus was quite recognisable in the first segment which had a fully developed cirrus pouch, and that segment was one of the earliest to have attained an appreciable length and lay hardly a millimetre behind the scolex. In this segment the uterus showed (in a longitudinal horizontal section through the anterior region of the body) a rounded form stretched in the direction of the transverse section of the body and thus rather oval in outline, and it occupied precisely the median region of the proglottid. In this particular uterus I found no ova. A segment or two further back the uterus is already larger, but it still has the form of a more or less oval sac, extending in these segments towards the pore-side and having thus become eccentric in position. The eccentricity, however, is not very strongly marked. In these segments the uteri were full of ova.

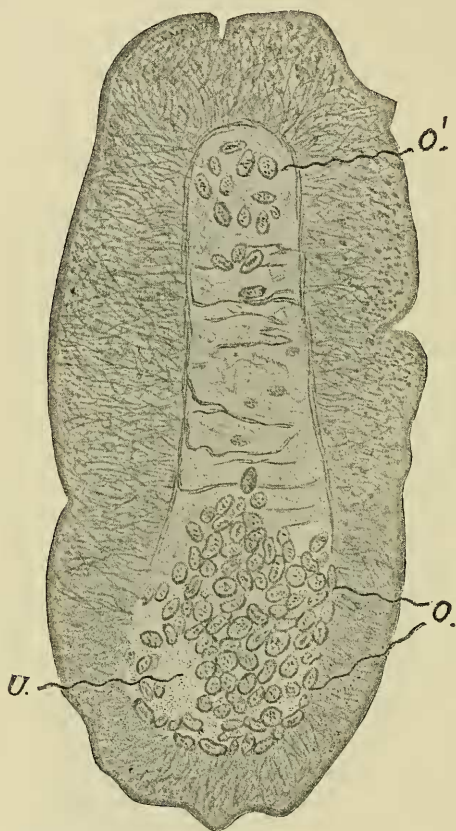
The uterus in these segments lay near to the posterior boundary of the proglottid and was transversely elongated in form; it was distinctly posterior to the strong muscular cirrus sac. The uterus possessed a distinct epithelial wall that was of sufficient thickness to show itself in all my sections (*cf.* text-fig. 210, p. 1007). Later, the epithelial wall is not obvious, but the cavity has plain boundaries and can be recognised as a definite cavity and not merely a system of irregular lacunæ.

In the posterior ripe proglottids the uterus undergoes some changes which are not altogether easy to follow and to correlate. When the elongated, fully ripe proglottids are examined mounted in glycerine, the eggs are seen to be arranged throughout them in a way which differs slightly in different proglottids but is as a rule at any rate on the same plan. The eggs occur in clusters and strings which give the appearance of a retiform uterus. In this, at times, a median string of eggs giving off lateral branches may be recognised. And though these lateral branches join here and there and thus make a network, the general appearance given in such segments is that of the uterus of *Tenia*, which is characterised by a median stem and lateral branches. Very commonly the ova are more thickly clustered together in the posterior region of each segment. There is, I think, little doubt that if the worm were examined only in this way, the uterus would be pronounced to be reticular. A study of sections, however, leads to a rather different interpretation of the arrangements visible in solid preparations. In some transverse sections, such as that illustrated in text-fig. 212, the whole of the interior of the proglottid is occupied by the uterus and the contained masses of developing eggs. These appear to lie in a large undivided cavity, which I take to be the uterus. This region corresponds to the posterior part of the segment, where as already mentioned the eggs tend to become massed.

In other sections through the same proglottid as that which has just been referred to, the conditions observable were different. There are, as is shown in the accompanying figure, eggs and

groups of eggs which correspond to the thinner strings of eggs in proglottids which are viewed as solid objects rendered transparent by glycerine. These groups vary in size, but it would appear that they are imbedded in the parenchyma of the medullary region and are not contained in cavities—that, in fact, there

Text-fig. 213.



Anoplotenia dasyuri, transverse section through ripe proglottid.

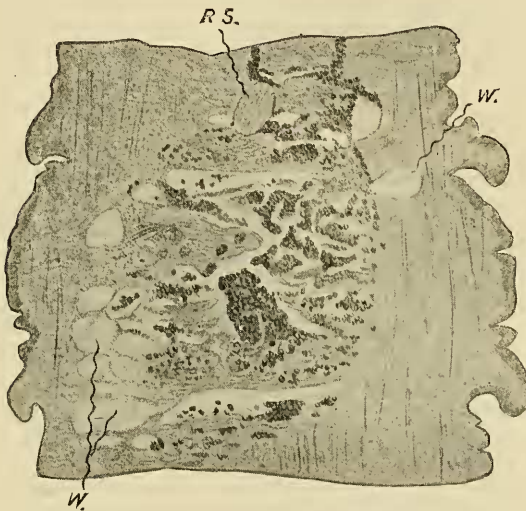
O., ova, contained in uterus (U); O', eggs scattered through parenchyma.

is no uterus here at all. It may, of course, have been present and have disappeared. In intermediate proglottids the uterus forms a series of cavities which apparently intercommunicate and thus constitute a network. In these cavities the eggs are not mature—at any rate, the membranes have not yet appeared. This system of cavities fills up a great deal of the available space

and the testes become much restricted and tend to disappear. The most noticeable part of the medullary tissue left is a projection from the region of the cirrus sac lodging the coil of the vas deferens.

It would appear therefore that the uterus in this genus *Anoplotenia* rather combines the characters of that organ in several other genera than presents us with a new type. That it passes through a simple saccular stage is not perhaps a fact of any great moment; for that occurs in many genera. But it is undoubtedly reticular at one time, and, contrary to what is found in such cases, the reticular stage is not permanent.

Text-fig. 214.



Anoplotenia dasyuri, longitudinal section through proglottid, showing the branched and reticular uterus with ova in smaller and larger clumps. R.S., receptaculum seminis; W., excretory tube.

The ultimate condition of the uterus does not fall definitely within any of the types used by Ransom in his table of arrangement of the genera of Tænioid Cestodes; and the condition of this organ in *Anoplotenia dasyuri* is really one of the chief reasons upon which I base its generic distinction from other forms.

The testes of this species are very numerous in those anterior segments in which they are at their full development. They are pressed closely together and overlap and appear to fill all of the available space left between the ovaries and other organs of the proglottid. As the latter are posterior in the segment, the testes are mainly anterior. Both in longitudinal and sagittal segments the testes can be seen to be limited in their occurrence only by

the cortex. In correlation with their large numbers, the testes are of small size. They cannot, obviously, be said to be either dorsal or ventral or anterior or posterior in position.

A good deal of the anterior part of each mature proglottid is occupied by a large coil of the *vas deferens* which forms a larger mass than in many tapeworms figured or known to me at first hand. Although this coil lies anteriorly in the segment on a level with the large cirrus sac, it does not touch the anterior boundary of the segment. In front of it there is to be seen a considerable heap of testes. The coil is generally in close contact with the cirrus sac. I found no vesicula seminalis in this species, but the coiled tube gets wider when ripe.

The *cirrus sac* and its contained structures are rather remarkable in this species and much more complicated than in many other species, including the three that I have already described in my former communication*. As already stated, the organs of reproduction appear very early in the chain of proglottids. It is, however, not for some segments that the cirrus sac is fully developed. The fully developed cirrus sac coincides with the first appearance of the uterus. As already mentioned, in considering the external characters of this worm, the cirrus sac when mature is so large as to cause an appreciable bulge in the segment. It therefore entirely fills the medullary region of that part of the segment where it occurs, as seen in a transverse section. In such sections it may also be seen that the cirrus sac and the genital cloaca together (of which a description follows) occupy about one-third of the entire breadth of a proglottid.

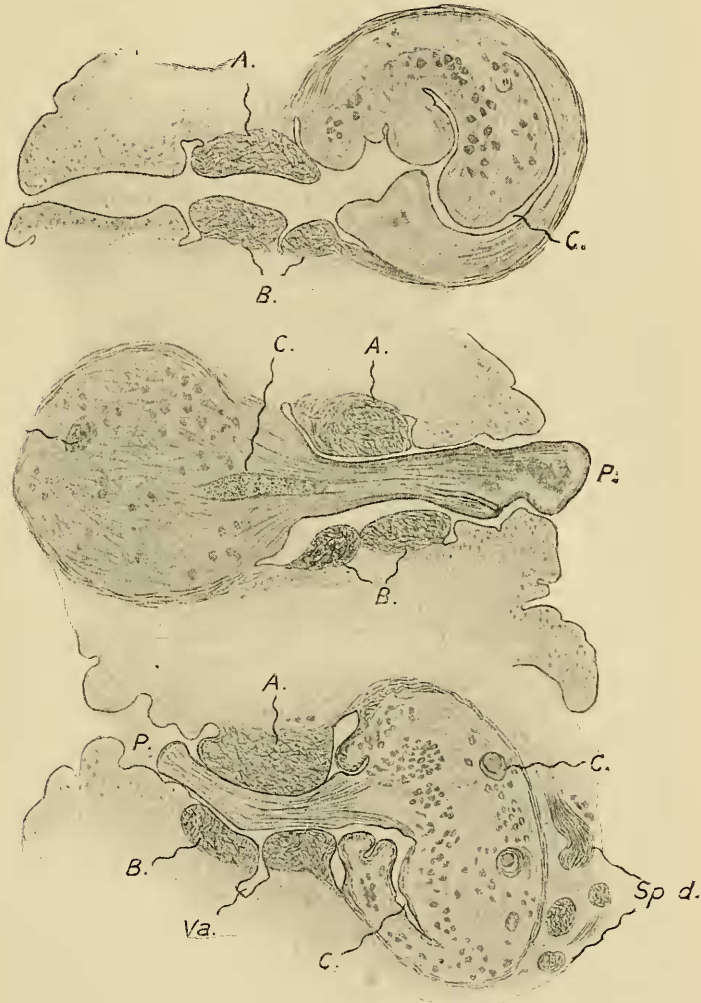
The cirrus sac is nearly if not quite spherical in shape, and consists of an outer coat and of an inner mass of tissue. The outer coat is not very thick and is muscular, the fibres no doubt serving to compress the sac and thus bring about the evagination of the cirrus. The internal tissue of the cirrus sac is a tissue in which the cirrus itself is embedded, and it entirely fills the sac save where it is traversed by the cirrus. It contains many nuclei scattered fairly closely throughout it, and delicate fibres which may be occasionally seen to possess a distinctly retiform arrangement. It seems to me to be a soft tissue which is an elastic packing material transmitting to the cirrus the contractions of the external muscular coat of the cirrus sac. In some sections indeed the nuclei can be seen to be more compressed and regularly arranged in lines in the immediate neighbourhood of the eversible cirrus sac. This might seem to argue some contractility possessed by the tissue forming the core of the cirrus sac.

The cirrus itself is peculiar and complicated in structure. It consists of two parts. First of all there is the part which lies immediately within the cirrus sac and which is perfectly continuous with the *vas deferens*, and shows no sudden differences

* P. Z. S. 1911, p. 626.

of structure that I can detect from the vas deferens. It lies in a loose coil of only two or three turns. Followed distally, this tube

Text-fig. 215.



Anoplotenia dasyuri. Cirrus sac with penis in various stages of retraction.

In the upper figure the penis is completely retracted, in the middle figure it is completely protruded; in the lower figure it is incompletely protruded. *A*, muscular pad on anterior side of genital cloaca; *B*, muscular pad on posterior side of genital cloaca which is perforated by opening of vagina (*Va.*); *C*, cirrus; *P.*, penis, on the posterior side of which, as is shown in the middle figure, the cirrus opens; *Sp. d.*, vas deferens.

is seen to open into an invaginated sac which lies pushed into the solid core of the cirrus sac, as is shown in the text-figure accompanying this description. This sac is irregular in form with crumpled walls, and it is surrounded by a layer of particularly stout muscular fibres, which lie therefore within the cirrus sac and form a differentiated portion of its core. These muscular fibres lie loosely round the invaginated sac. The wall of the latter is rather thickened to form a pad lying on the anterior side, and close to this the cirrus opens into it, their cavities becoming continuous. The opening into the sac is opposite to the pad, and therefore on the posterior side of the sac.

The cirrus sac does not open directly on to the exterior, but through a genital cloaca which is itself much complicated. A horizontal section through the whole structure is represented in text-fig. 215. The genital cloaca may be divided into three or four regions; the invaginated penis (as we may term the in- and evaginable sac into which the cirrus opens) is continuous with a wide but narrow cavity of quite as great a diameter (antero-posterior) as the cirrus sac itself, but very narrow from side to side. After this comes a tubular cavity surrounded by a very thick layer of circular fibres which are perforated, as already mentioned, on the posterior side by the vagina which here enters the genital cloaca. In horizontal sections such as that represented in text-fig. 215, this layer of muscles appears as two strong muscular pads, that on the posterior side being longer from side to side than the one opposite. After this the canal widens a little for the terminal part of its course and its walls are rather crumpled, there being a particularly deep recess immediately after the sphincter region which precedes it. A considerable portion of the cirrus sac can be evaginated, sometimes more and sometimes less. These differences also are shown in text-figure 215. In some cases only the anterior side of the cirrus sac is protruded, which in such a case barely reaches the external orifice of the genital canal. In other cases much more is protruded, and the cirrus itself is drawn down into this penial protrusion which extends well beyond the external orifice. In this latter case, however, which represents the extreme of what I have seen in my sections, the actual opening of the vas deferens is not at the tip of the protruded penis, but at the side and within the genital canal. I may not perhaps have seen instances of extreme protrusion. It is noteworthy that the orifice of the vas deferens is on the posterior side of the penis and thus corresponds to the vaginal orifice. Possibly a complete extrusion of the penis takes place in cases of cross-fertilisation.

The following are the general characters of this species* :—

Head quite unarmed, of rather large size and with four unarmed suckers. Strobilisation begins at once, there being no "neck"; the first two or three strobila wider than those which immediately follow

* I do not attempt to discriminate between generic and specific characters.

and of same diameter as or wider than head, thus forming a rudimentary pseudoscolex. The proglottids increase very rapidly to a considerable length, the posterior being longer than broad and becoming detached. Not more than ten or a dozen anterior short proglottids. Genital orifices single and irregularly alternate. Excretory tubes posteriorly one on each side of body, that of one side being as a rule wider than that of opposite side; in anterior segments two on each side. Testes very numerous, filling up the whole space left by other organs in proglottid. Vas deferens coiled. Cirrus sac very large and spherical and somewhat peculiar in structure, with an eversible sac reaching the exterior through a much differentiated genital cloaca. Ovaries posterior in segment and with vitelline glands posterior to these. Vagina straight and narrow, opening posteriorly to cirrus sac; a receptaculum seminis present. Uterus at first a simple sac, later a reticulum, and later still part of the uterus remains, while other eggs are imbedded singly or in groups in the medullary parenchyma. Eggs without V-shaped apparatus.

It will be, as I think, evident from the résumé of the characters of this species just given, that it cannot be referred with any confidence to any one of the really known genera of the Tetra-cotylea. The convenient table giving a key to the various genera used by Ransom in his memoir enables one to refer the species from *Dasyurus ursinus* to the neighbourhood of *Oochoristica*, *Tenia* (s.s.) or *Bertiella*. Of the latter genus several species are known from Marsupials; but they are not known from the present genus, and appear to be nearly limited to the herbivorous (at any rate Diprotodont) genera, i. e. *Phalanger*, *Phalangista*, and *Phascolarctos**

These species, however, are certainly not congeneric with that which I describe in the present paper. They agree with the generic definition given by Ransom†, who doubtless took them, as well as the species of *Bertiella* from Apes and Rodents and Birds, into consideration when formulating his definition. The worms studied by myself show the following important differences from *Bertiella* as defined by Ransom:—The strobilisation is different, the posterior strobila being much longer than broad; the genital canals pass between the dorsal and ventral excretory vessels; the testes exist throughout the segment save where space is occupied by the ovaries etc.; the uterus is of a totally different character; the cirrus sac is also totally different from anything figured in *Bertiella*. I do not feel able therefore to refer this species from *Dasyurus ursinus* to the genus *Bertiella*.

I am of opinion that the present genus is nearer to the genus *Oochoristica*. The latter genus actually occurs in carnivorous Marsupials but in Neotropical forms, in fact in *Didelphys*, and not, however, so far as I am aware, in Australian Marsupials. The

* See Zschokke in Semon's 'Reise,' Jena 1898, for *B. obesa* and *B. semoni*; and the same author, "Neue Studien an Cestoden aplacentaler Säugethiere," Zeitschr. wiss. Zool. lxx. 1899, for *B. edulis* and *B. sarasinorum*. Also Janicki, "Die Cestoden Neu Guinea's" in Nova Guinea, Livr. v., 1906, p. 281, for *B. rigida*.

† *Loc. cit.* p. 62.

general form of the body and the segmentation is not unlike in the two genera; and especially to be noted is a resemblance in the scolex. In the present genus as in the *Oochoristica* from *Tamandua tetradactyla*, described by myself* some months since, the strobila, as it were, invade the scolex. On the other hand, the early disappearance of the uterus and the imbedding of the ova singly in the medullary parenchyma is a character of *Oochoristica* which distinguishes it from the genus which I propose to call *Anoplotenia*. The peculiar cirrus sac and the very complex genital cloaca are points in which *Anoplotenia* differs from all the genera with which I here compare it.

There now remains the genus *Tenia* (*sensu stricto*) to which the present species shows a certain amount of likeness in the uterus, which is rather pronounced in certain proglottids. There is in fact occasionally a quite distinct median stem with branches. *Tenia*, however, has an armed rostellum which is sometimes not armed as in *T. (Teniarrhynchus) saginata*, where the hooks drop out early and are replaced by a sucker-like structure†. There is nothing of this kind in the present species, which moreover bears no such close likeness to *Tenia saginata* as would warrant its inclusion in the same genus or subgenus. Another genus in which the uterus has a marked median stem and lateral branches is *Catenotenia*,‡ the species of which occur in the mouse and in the squirrel. In this genus, however, the testes and ovaries have a different position from that which is met with in the tapeworm dealt with in the present memoir, and the relation of the genital duct to the excretory tubes is also different.

46. Some Madreporaria from the Persian Gulf. By RUTH HARRISON, Oxford §. With a Note on the Memoir and some Further Notes on *Pyrophyllia inflata* by SYDNEY J. HICKSON, M.A., D.Sc., F.R.S., F.Z.S.

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(Plates LVII. & LVIII. || and Text-figures 216-221).

This collection of Madreporarian corals was made by Mr. F. W. Townsend, and entrusted to me for identification and description by Professor Hickson. I should like to take this opportunity of thanking Professor Hickson for putting this interesting piece of work in my hands. My thanks are also due to Professor Bourne for allowing me to carry on the work in his laboratory and placing all its resources at my disposal, and for help and advice during the

* P. Z. S. 1911, p. 627. I ought to have mentioned in that paper that something of the same kind appears to occur in *O. rostellata* (see Zschokke, Zeitschr. wiss. Zool. vol. lxxxiii. 1905).

† Cf. Bronn's "Thierreich," Vol. iv. Abth. B, p. 1720.

‡ Janicki, Zeitschr. wiss. Zool. 1906, vol. lxxxi. p. 505.

§ Communicated by Prof. S. J. HICKSON, F.R.S., F.Z.S.

|| For explanation of the Plates see p. 1044.